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ABSTRACT

This chapter discusses General Systems Theory as it applies to education, classrooms, innovations, and instructional design. The principles of equifinality, open and closed systems, the individual as the key system, hierarchical structures, optimization, stability, cooperation, and competition are discussed, and their relationship to instructional design and development are considered. Six figures are provided. (17 references) (Author/EW)

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Chapter 3

Educational Interpretations of General Systems Theory

William E. Hug
James E. King

Are instructional designers also systems analysts and do they practice General Systems Theory? Not according to the following chapter. It addresses the concept of equifinality, how innovations are displaced by the re-establishment of equilibrium and other points related to General Systems Theory.

The literature of General Systems Theory develops concepts that help describe physical, biological, and social systems. During the past decade the use of General Systems concepts has become fashionable even though these basic concepts frequently appear to be misunderstood. This is especially true in instructional and curriculum design and in instructional materials development.

INSTRUCTIONAL DESIGN, SYSTEMS ANALYSIS, AND GENERAL SYSTEMS THEORY

The most common conception of the application of General Systems Theory in educational reform is that application associated with performance and competency-based educational programs. In the minds of many, a program which has been derived from explicit objectives which are tested by criterion-referenced tests is an application of General Systems Theory and systems analysis. Actually, there is frequently little visible evidence as to the extent that instructional design models like those of Gagne and Briggs (1979) and systems analysis as conceived by Daniels and Yeates (1971) relate to the basic concepts of General Systems Theory. In fact, neither Systems Analysis (Daniels and Yeates, 1971) nor Principles of Instructional Design (Gagne and Briggs, 1979) indexes the term "General Systems Theory." Nevertheless, curriculum workers, educational technologists and others frequently justify their approach to program design in terms of General Systems Theory, when the assumptions and procedures used actually better fit the rubrics associated with instructional design and systems analysis.

Banathy enumerates the implications of a General Systems view of education (1976):

- the simultaneous consideration of the four levels at which education systems operate--the societal, institutional, instructional, and learning experience level--as well as the understanding of the interdependence and dynamic interaction of those levels.

- the definition of the key entity around which each of the systems is organized (at those four levels) and the designation of the primary systems level in the systems hierarcy.

- the interactive consideration of (1) the context or environment in which the education systems exist, (2) the outcomes or

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> products that are to be produced by each of the four systems, (3) the functions that are to be carried out to bring forth the outcomes, (4) the structure of systems components, and (5) the processes applied in the operation of the system.

The differences between instructional design or systems analysis and General Systems Theory can best be seen by understanding the purpose for which each exists. Instructional design is a systematic set of procedures for generating, implementing, and evaluating educational programs. Numerous industrial operations use systems analysis in a similar way and for like purposes. General Systems Theory, on the other hand, emphasizes the study of a whole entity by understanding the functional relationships existing among the components of all systems. The task of this general science of "wholeness" lies in the formulation of valid principles for systems regardless of the characteristics of their parts or the relationships among the parts of the system (Bertalanffy, 1968). As such, General Systems Theory provides a way of thinking about a functioning system rather than a prescriptive set of propositions (Lederman, 1976).

Another difference between instructional design or systems analysis and General Systems Theory relates to the linear or non-linear nature of each. For example, the instructional designer may start by constructing a test that adequately samples some performance and then write the objectives and design the learning activities. More commonly, the instructional designer will conduct a task analysis, write performance objectives and criterion measures, design learning activities, and identify components needed to make the instructional system operational. The point here is that the steps used by instructional designers and systems analysts tend to be linear.

This linear logic is not followed by General Systems Theory. Rather, General Systems Theory highlights the inadequacies of a linear ends-means view of a system and emphasizes the reciprocal relationships among systems. In social and other man-made systems, the goal of the system may remain constant while the means shift dramatically (Ball, 1978). For instance, the widespread use of computers in elementary and secondary school classrooms could bring about a dramatic shift in means even though the goals of the curriculum could remain the same.

Bertalanffy describes why linear logic is in conflict with the goal of General Systems Theory (1975).

> The goal of general system theory is clearly circumscribed. It aims at a general theory of wholeness, of entire systems in which many variables interact and in which their organization produces strong interactions. It does not deal with isolated processes, with relations between two or a few variables or with linear causal relations.

The purpose of making this distinction is to point to the need to look at the principles of General Systems Theory in order to understand better why educational institutions and programs are as they are. If General Systems Theory has a language rich enough to accurately describe an institution and an educational program, then educational planners have a foundation upon which to build.

THE CLASSROOM AS THE KEY SYSTEM

In order to identify key systems within a larger unit such as a school district, the place in which the work is done that accomplishes district purposes must be determined. Theoretically, this is any place in which a student gains the knowledge, the skills, and the attitudes that are part of the district curriculum. Obviously, the broad scope of this theoretical statement makes it all but impossible to analyze the key systems so defined. More traditionally, the key system is considered to be the classroom, the key components are students, educational materials, and the teacher. If the classroom is considered the key system, learning activities within the classroom then become subsystems and provide the means for attaining class objectives, which, in turn, support the purposes of the school and the district. The role of the district and school relates to the way they support the classroom and protect its integrity.

The classroom provides the environment that can be analyzed in terms of the purposes for which school exists and in terms of the relationships among elements that nurture certain effects. For example, Mary Budd Rowe (1974) at the University of Florida has discovered that teachers wait only a few seconds for the answers to questions they ask students. In her research in the United States and Australia, she found that both the frequency and the accuracy of students' responses dramatically increase when teachers extend the time given to students to answer questions. When a teacher, conscious of this research, extends the time s/he gives students to answer questions in order to improve student performance, the relationships among the elements in the class have been changed to nurture more correct and complete responses from students.

THE INDIVIDUAL AS THE KEY SYSTEM

All living things, including humans, are well-defined, concrete systems. For example, their hierarchical structures are well known (e.g., cell, tissue, system, organism) and their physical boundary is clearly defined, thus permitting careful study of what living systems need from their environment as well as what they contribute (e.g., plants take in carbon dioxide and give off oxygen). These observations prompted Greenebaum to argue

that the student is the key system (1976):

> . . . students have clearly defined outputs but unobservable processes; schools have poorly defined outputs but observable processes. A general theory, then, ought to help us think about student processes and school outputs in a way that conventional discipline-bound theory cannot.

The statement seems to ignore the classroom, which is the designated environment in which teaching and learning take place.

Everyone recognizes that degrees of physical and emotional stability in students are necessary prerequisites if students are to benefit from class activities. There are always conditions that facilitate and conditions that obstruct or even make some classroom activities impossible to undertake. There are also drugs that change the human body in such a way that the individual can be made more alert, can be made to remember better, or can be tranquilized. These drugs may affect a student's readiness to learn; however, the actual opportunity to learn depends upon experiences provided for in the environment.

The problem with considering the student as the key system is that educators are likely to pay too much attention to the black boxes and give less attention to the purpose of an educating system.

BLACK BOXES

When understanding an operation or function is unrelated to accomplishing a task, the operation is called a black box. For example, a teacher places a reassuring hand on a child who is attempting a difficult task and the child responds by relaxing and trying again. The act of reassuring does not require that the teacher know the chemical and physical changes that occur in the child's body that caused the child to relax. These changes in the state of the body are called black boxes.

The concept of black boxes can help identify irrelevant information and activities in the curriculum as well as help educators to place priorities on certain activities. For example, an objective of driver training is to teach students to use the brakes properly. Teaching the workings of a hydraulic braking system will not help students achieve this objective. In other words, those who use brakes properly may or may not know the mechanics involved. The mechanism is a black box. The activity with the highest priority is practice during driving lessons with the student behind the wheel.

OPEN AND CLOSED SYSTEMS

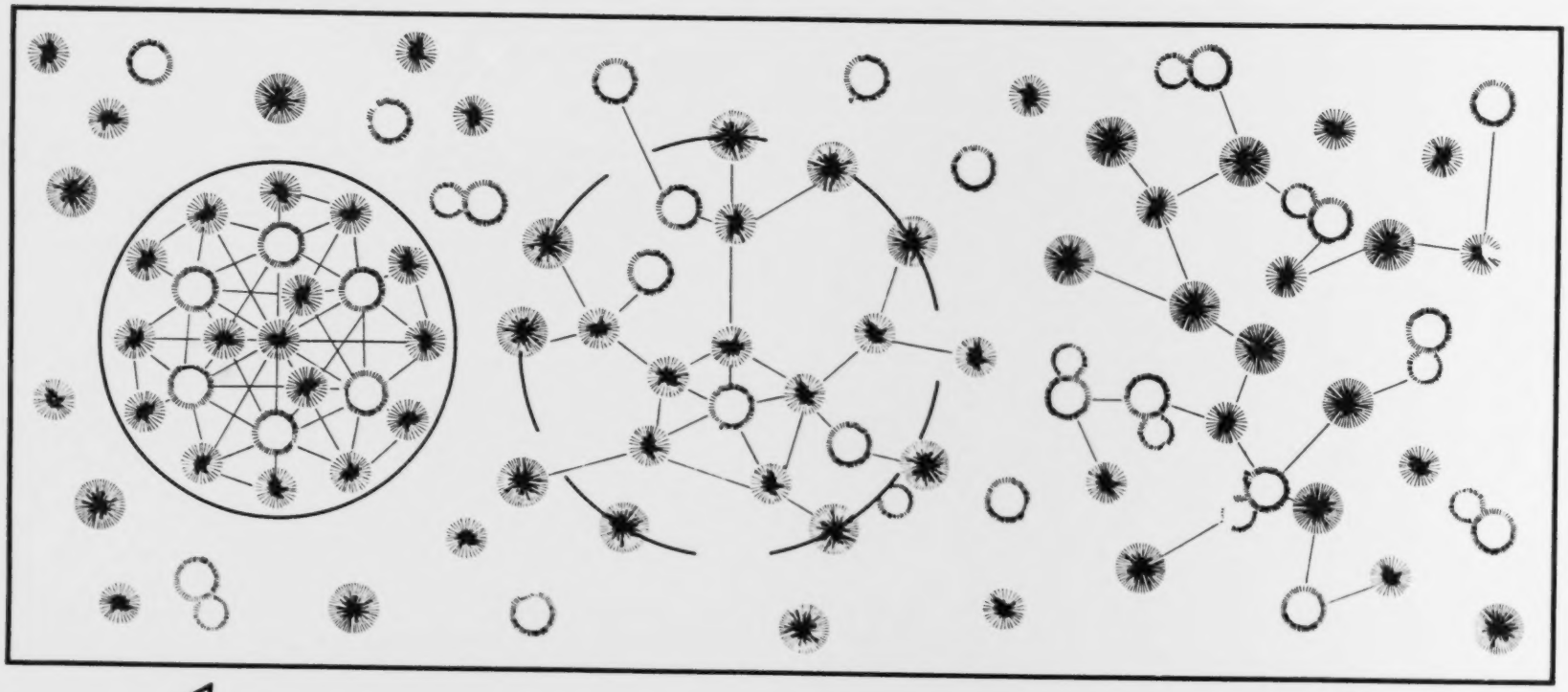
The concept of open system and closed system is confusing in that neither exists in the complete sense of the term. This is because there is not such a thing as a completely open system or a completely closed system. As illustrated in Figure 3-1, a completely open system does not exist because its boundary could not be identified. The completely open system would dissolve into its environment. On the other hand, a completely closed system would be a kind of perpetual motion machine that would never run down. Since neither of these systems exist, thinking about the degree to which a system is open and closed means placing the system on a continuum stretching from open to closed in relation to other systems on the continuum.

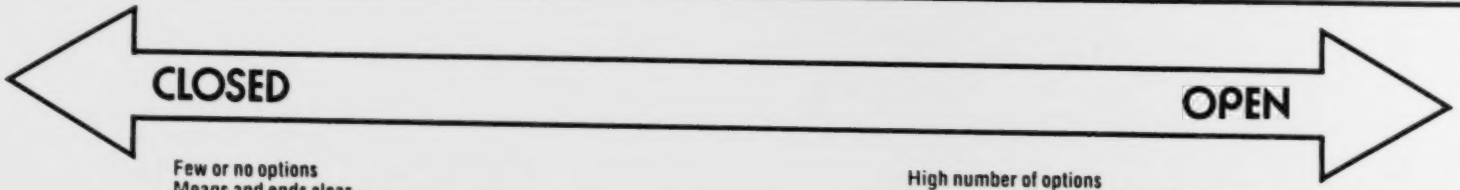
As related to a class, school, and district, a system is a complex of physical, personal, social, procedural, and content components interacting for a variety of purposes. The degree to which a classroom is open or closed depends upon the way and degree in which components and purposes relate to the school, district, and community. If there is a high degree of interaction with these environments, the classroom is more open than if little interaction takes place. If there is little interaction and the classroom exists for its own purposes, then the system tends to be more closed.

This is not to say that a closed system cannot serve a purpose for its environment or that all open systems are relevant. In other words, closed systems do not necessarily mean "bad," and open does not necessarily mean "good." The assumption is too frequently made that when one opens up the system, something positive will happen. In education, the open school concept is frequently considered better than the concept of a closed classroom. Questions of efficiency and effectiveness relate to the creative and scientific arrangement of components to achieve purposes. The key is to support the educational system having the most order and strongest relationships among the people, materials, and facilities that support learning. Using General Systems Theory as an argument for creating more open systems is a gross misinterpretation.

The question of open and closed systems within a school district must be resolved by identifying which systems need to be more closed and which need to be more open in order to accomplish their respective purposes. There is no way of going about this in any absolute sense. Nevertheless, some observations seem obvious. For example, one teacher responsible for teaching 35 students in a self-contained classroom having 35 desks and 35 textbooks needs a relatively closed system to maximize the relationships in order to accomplish class objectives. Bells, cold and heat, interruptions, noise and other disturbances can destroy the internal order of the classroom and block progress during a lesson. On the other hand, the office of the superintendent needs many channels to respond to the numerous concerns of individuals and organizations within the community. Consequently, the office of the superintendent cannot achieve its purpose unless it is communicating freely with the

Figure 3-1. Open and closed systems.





Few or no options
Means and ends clear
Needs little communication with supra-system
High degree of internal order

High number of options
Means and ends changing and often obscure
Free communication to and from environment
Internal order flexible

community.

Other characteristics besides the exchange of a system with its environment help distinguish among closed and open systems. For example, in open systems, there frequently exist a number of options in components, procedures, order, and other resources while more closed systems tend to have fewer options. Consider the number of options available to a district superintendent as contrasted to a classroom teacher. The superintendent has control over a wide range of monetary resources, can be at a wide variety of places at any time of the day, and has access to numbers of specialists both within the school and community. The classroom teacher has little or no budget, has a fixed schedule throughout the day, and neither the time for nor access to a wide variety of expertise.

INTERRELATIONSHIPS AMONG SYSTEM COMPONENTS

One way to recognize a system is to note how the elements that make up the system are "communicating" with one another, to look at the relationships among components. For example, as shown in Figure 3-2, four lines of equal length can form a square, the letters TV, or a box with the lid open. The relationships among the lines enable one to interpret what the thing is. In this way, a system is frequently unknown until its organization is understood.

Figure 3-2. Selected ways four lines can communicate.

The general ethos of a class emerges from the interrelationships among components. Hostility, friendliness, motivation, directedness, apathy, sympathy and joy are all products of the relationship among components. These outcomes or products are frequently states that are of non-physical nature (Pia, 1976) and are generally expressed in words (Miller, 1970). In thinking about the classroom in this way, the attributes of the components are far less critical than the relationships that produce these conditions. Consequently, a wide variety of students with great variations in intelligence and background can interact to produce these conditions. However, the attributes of the elements do, in some cases, place constraints upon what relationships develop, the personality of the teacher being a case in point. Miller expresses these ideas in this way (Miller, 1970):

> The spatial structure of the class importantly influences its processes. If students are arranged at desks facing the blackboard or television set, their interactions are different than if they are arranged in a circle or if they are arranged at laboratory benches. The classroom process varies also with the content of the information discussed and the teacher's approach to interpersonal reactions which is often dictated by the teacher's philosophy of education.

Studying the relationships among components of the classroom helps to avoid thinking about a system apart from what the system does. Thinking that a classroom is a classroom regardless of whether it is being used is not very useful. Thinking about a classroom as a place where one might participate in a drama, view a film, enter into debate, conduct an experiment, paint a picture, or play basketball makes more sense. The questions asked by General Systems Theory about such activities relate to how the classroom holds together, achieves its purposes, and moves toward a more optimal state.

If a classroom is highly integrated, each of the elements has strong, well-defined interrelationships. In other words, the facilities, teacher, information resources, and students become critical to students' achieving educational goals. Each component plays a distinctive role in the overall functioning of the classroom (Pia, 1976).

The concept of synergism, synchronized energy, involves the importance of developing systems with highly integrated components (Pilecki, 1972). In other words, a functioning classroom should produce something more than the sum of its parts. For example, the knowledge, skills, and attitudes developed in the various subjects work together to form more and more sophisticated intellectual structures. The concept of synergism might also be used to explain certain types of heirarchical structures. For example, a painting of a landscape is more than color, perspective and design. Valuing is more than a lot of respect, and so on. The principle from General Systems Theory is that as the system becomes more integrated the chances of increasing the synergistic effect of the system also increases.

HIERARCHICAL STRUCTURES

The architecture of any system invariably contains hierarchies which account for the ubiquitious nature of hierarchical structures in General Systems Theory. The levels of the cognitive domain include knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, et al., 1956). Classrooms make up schools, schools collectively form districts, and so on. Expressions such as "knowing one's place" and "climbing the ladder" are common in everyday language and in the folklore of all cultures (Milsum, 1972).

Vertical and Horizontal Structures in Schools

The concept of vertical structure is commonly associated with the chain-of-command--the teacher, principal, superintendent--or the kindergarten-through-high school curriculum as shown in Figure 3-3. Horizontal structure frequently refers to the kind and number of teachers that make up the faculty or to the course options available on a specific level.

The vertical and horizontal structures of the curriculum control what a student may be doing at any given level as well as what the kindergarten-through-senior year experience is designed to produce. The clearer these structures are the more the system is in control and the more each person and each activity are vested with purpose and meaning. As shown in Figure 3-3, the curriculum is a planned series of experiences extended over time.

The vertical and horizontal structures of the curriculum show what the options are. What actual experiences students have is related to the way the educational system is organized and supported to make the options accomplish purposes.

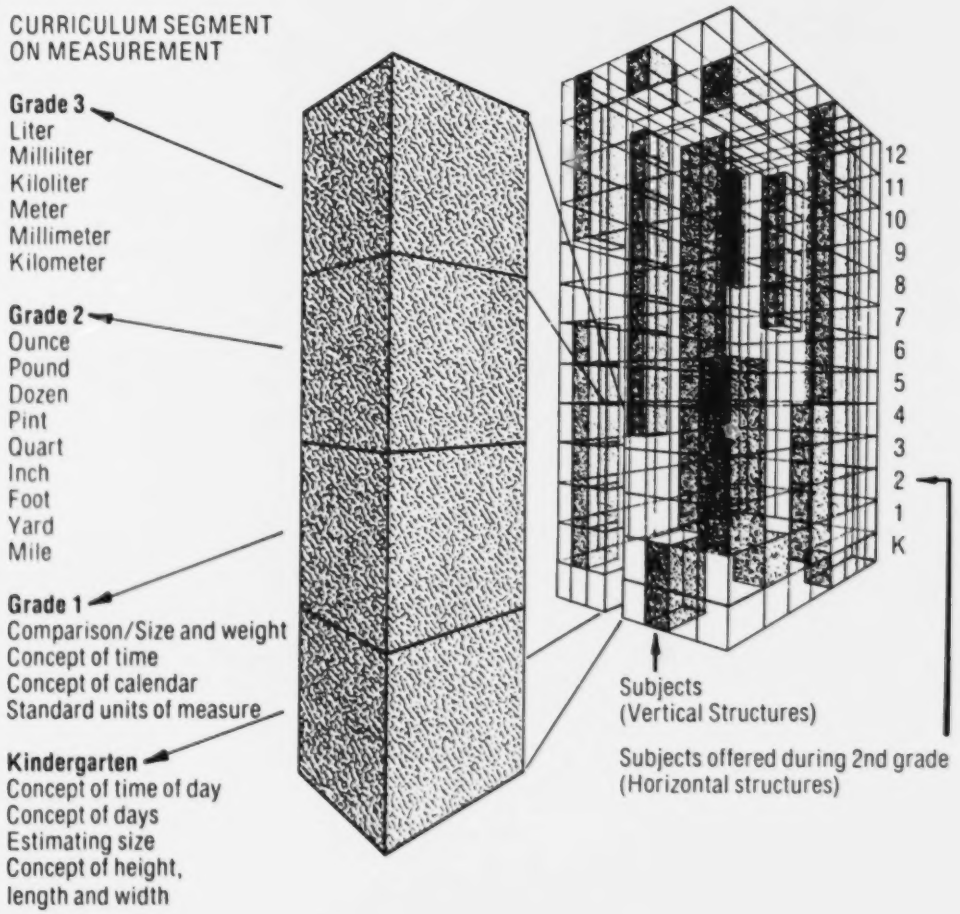


Figure 3-3. Vertical and horizontal structures of the school curriculum.

Hierarchies in Subject Matter

The vertical structures of the curriculum attempt to match natural hierarchies within the various disciplines. In most sciences the natural hierarchies are visible. In other disciplines, like history and language arts, more artifical structures are used to form hierarchies. Examples include thematic approaches, from simple to complex, from facts to conclusions, by chronological order, and from whole to part. Another order of hierarchy found in the various disciplines relates to the processes used to bring new knowledge to the field. Historians analyze original documents, scientists use the experimental method, and biochemists synthesize DNA.

Another way to look at the hierarchical order in the disciplines is to see that all disciplines are engaged in the study of systems, all of which have hierarchies within them. Thus the social scientist is concerned with systems such as the family, town, county, state, nation, and world; the language arts teacher is concerned with how and why words, sentences, and a sequence of ideas function in a given paragraph; the astronomer strives to describe the complex nature of the universe.

Hierarchies in Human Development and Learning

Educators must comprehend the importance of describing those characteristics of students that significantly affect the relations among components that are needed to achieve learning goals. Student characteristics that affect content, format, and message design are significant. Some of these characteristics need to be considered in curriculum design, others in curriculum implementation, and still others in curriculum evaluation. For example, the middle school curriculum reflects the formative, exploratory nature of the adolescent and his desire to gain group approval. Other characteristics, such as the need for active involvement at the adolescent as well as other ages, are important in the design of teaching and learning activities. In other words, a general understanding is needed of student characteristics unique to each period of the human life span.

Every stage of the human life span presents a unique opportunity to communicate, to learn, and to change, since each stage represents different needs of human beings. For example, the relationships among levels of interaction change from infancy to childhood, from childhood to adolescence, and from adolescence to adulthood. Figure 3-4 illustrates the changing environment of people during various stages of their lives.

The way educators capitalize on the needs of each level can make the difference in whether or not the curricular objectives are realized, needed, and/or accepted. There is no cut-and-dried method for such an analysis: there is only knowledge that will help educational planners act more responsibly, more intelligently, and more sensitively. The purpose, in the context of General Systems Theory, is to improve the relationship among the educating systems components.

For example, early childhood may be characterized as a socialization process. Activities that promote working together, that provide simple structures that are easily followed, that allow all to succeed and to have fun in the process, and that allow for role playing are most appropriate. This is a time when rich and real experiences are provided and talked about. Preschool children and children in the early grades do not want to wait for their rewards. They value what is going on now. Activities that help children come close to their environment will be enthusiastically accepted. A curriculum developing skills such as cooperation, discussion, respect, courtesy, manners, and friendliness are appropriate. This is the time when large muscles are being developed and consequently activities promoting balance, basic coordination, and pace are valuable.

Educational planners must realize that children are bewildered if surrounded by too much permissiveness. Consequently, educational programs for children should provide directions, routines, and consistency. Underlying all activities designed for children should be the realization that children are in search of self; that they need to understand better how they fit into the group and into the community.

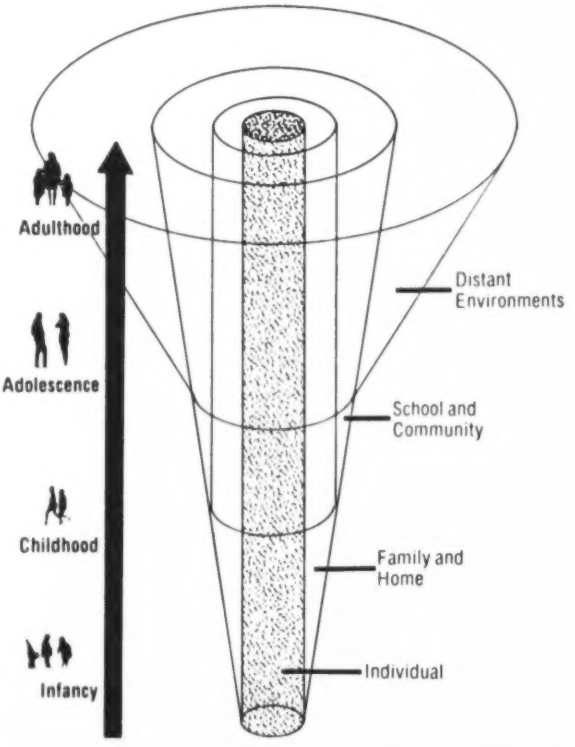


Figure 3-4. Relationships among levels of interaction and human growth and development.

Another developmental hierarchy is the acquisition of language, the relationship to learning to read, and the way language moves a child, adolescent, or adult from the concrete to the abstract. For example, oral language develops first and is necessary before a child begins reading.

Adolescents differ in a number of ways from children. In "Bread and Butterflies: A Curriculum Guide for Teachers" (1974), an excellent audience description exists for nine-to-twelve-year-olds. The television series is designed to help this group understand themselves and the world of work. The teacher guide describes eight characteristics nine-to-twelve-year-olds have in common.

> They have the widest range of interests of any age group.
>
> They are fascinated by realism and facts. Achievement is very important. Success is elating, failure a disaster.
>
> They have begun to question the right of adults to dominate.
>
> They want to make their own decisions and assume responsibility, initiative, and independence regarding things they see as important.
>
> They are beginning to be aware of other people's feelings, beliefs, and ideas. They can understand the concept of fair play.
>
> They find a certain amount of satisfaction in working alone, but they really enjoy group enterprises.
>
> They seek prestige. It is important to be somebody, to do something great, to achieve recognition.
>
> Physically, they are developing body control, strength, and endurance.

Other forms of hierarchies exist in human development and learning. For example, Maslow has structured the evolving psychological and physiological needs of humans. The cognitive, affective, and psychomotor domains have been structured into hierarchies. Another example is the work of Taba. She developed a technique for the hierarchical ordering of questions. The point is that the many kinds of hierarchies which exist help educators to understand what is happening and what can happen.

Competition and Cooperation in Schools

A combination of competition and cooperation is found on each level of the hierarchy from classroom through the school district. However, an important point to note is that competition at one level of the hierarchy may be identified as cooperation on another level (Milsum, 1972). For example, competition among students in the classroom may be viewed by the school as a means for encouraging high student achievement. At the school level, this competition is cooperating with a purpose of the school. In the classroom, the competitive aspects of teaching and learning and the cooperative aspects exist at the same time and tend to reinforce each other. For example, in the school band, the more competitive the band is, the more satisfying the cooperative experience.

Notions of competition and cooperation may explain why innovations intended to change the traditional classroom experience tend to be short-lived. Milsum states the principle from General Systems Theory in this way (1972):

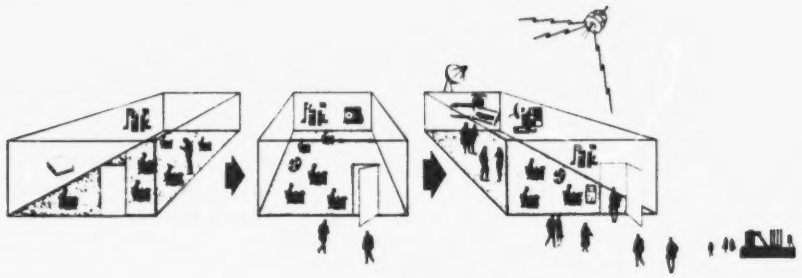
> If particular subsystems of a larger system operate so as to optimize their own individual "good" (performance indices), the net result will almost never be overall system optimization.

Milsum goes on to explain that all of the subsystems, in this case the classrooms, draw upon common resources (school and district). In this sense, the innovation tends to have a greater share of the school and district resources than does the traditional classroom. If this is carried to the ultimate, the common resources could be depleted and result in the mutual ruin of all concerned.

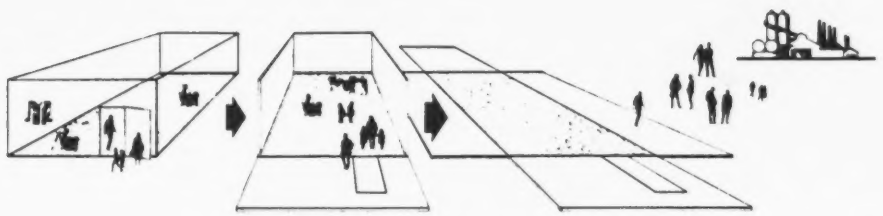
Optimization

The optimal structure and size of a classroom, school, and district relate to the degree of specialization needed on each level of the hierarchy to achieve purposes. The degree of specialization is the key here since specialization is related to the capacity of the system, whereas organizational aspects may be more arbitrary. There are many ways the school can organize its classes, and many ways classes can organize learning activities. Nevertheless, the viability of the concept of the classroom as the key system is tested by its ability to grow in complexity, sophistication, and specialization.

For example, at the turn of the century classrooms contained desks, slates, textbooks, and only a few additional learning resources. Today, two trends can be seen. The first is to bring the world to the classroom with sophisticated facilities, elaborate electronic devices, and information systems, as shown in the top series of illustrations in Figure 3-5. The second trend is to bring students from the classroom into the communities. The question is not, which trend is "better" or "right." The question is, which environment best serves the educational purposes. An important consideration in judging which environment will best serve the educational purposes must take into account **what is practical** and **what provides for optimal control.** In this sense, the great diversity



SYSTEMATICALLY BRINGING MORE OF THE WORLD INTO THE CLASSROOM



SYSTEMATICALLY TAKING MORE OF THE CLASSROOM INTO THE WORLD

Figure 3-5. Two trends in education.

among classrooms is related to the many purposes for which each exists and attests to the soundness of the original concept of the classroom.

Stability

Concepts describing equilibrium, homeostasis, and steady state are used to ascertain the stability of a system. All systems have some mechanism which helps maintain stability. A simple thermostat used to maintain a constant temperature is an example of such a mechanism. The legislative, judicial, and executive branches of government provide another example. The purpose of these mechanisms is to return the system to its original state when changes occur which disrupt a system's stability.

The number of such mechanisms that exist to protect the classroom system in public eduction accounts for its stability. In most states, the classroom teacher is the one who is legally responsible for instruction. The administrative rules and personnel are designed to protect the classroom and to maintain its stability. Any innovation that strays too far from the normal classroom concept seems to have little chance of success for the classroom always returns to the traditional in response to the continual pressure from the existing powerful mechanisms.

Stability in the classroom or in other systems may be maintained in at least three ways. First, the environment can change. For example, the school is the immediate environment of the classroom. In open schools (schools without walls), the boundaries that separate classrooms are missing. When this causes problems the school can use bookshelves, portable blackboards, screens, and other devices to establish boundaries between classrooms and to simulate the privacy of the classroom. Second, the system can change internally in order to increase its ability to regain stability. Sending a disruptive student to the office is an example of this type of internal change. Third, a combination of internal and environmental changes may take place to bring about greater stability. For example, a new science curriculum was introduced into the middle school. Teachers were not properly prepared to implement the new curriculum and began experiencing a number of problems. Students were not obtaining the proper results from experiments. Teachers could not answer the questions students had about many of the new concepts, and so on. This caused a great deal of frustration, uncertainty, and sometimes chaos. In order to correct the situation, the district organized a series of workshops planned to overcome these problems. The workshops were designed to change both environmental as well as internal order and thereby establish a higher degree of stability in the classroom.

As far as classrooms and schools are concerned, the more energy that is spent in

establishing and maintaining corrective mechanisms the less likely educational purposes may be achieved. There are many examples that illustrate this point. Too many restructions placed on students using the school library media center will begin to defeat the purpose for its existence. Teachers who constantly bring mechanisms into play to keep discipline obviate many activities which are easily managed by classroom teachers with few discipline problems. Even though an activity may be absolutely essential to gaining a particular understanding, if the teacher feels that students will be in physical danger because of their lack of discipline, the activity will most likely be avoided.

Notions about stability perhaps reveal a basic myth many educators hold--the larger a school the more effective and efficient the educational program. A large school saves the district money because the district does not have to duplicate expensive facilities. Facilities are better utilized in larger schools. A large school can provide a more diverse curriculum and thereby meet the needs of more students within the community and so on. However, large inner-city schools usually spend much more money and energy to protect property and to provide for the safety of students than do small schools. In fact, few mechanisms are needed to protect property and to provide for the safety of students in schools small enough to allow every student to know every teacher and every teacher to know every student.

Some corrective mechanisms used in the classroom help provide more ways for students to achieve personal and program objectives. Such mechanisms may be designed and employed by teachers and students or be present in educational materials. For example, the teacher may re-teach a lesson using different examples because students failed to perform satisfactorily on a test, a student may make up and work multiplication problems to increase this skill, and a piece of programmed instruction might have a remedial loop for students that need certain prerequisite skills before they can proceed. In these instances, the type of corrective mechanism employed also increases the equifinality of the classroom.

Equifinality

Man rarely, if ever, creates a perfect, ideal, or best system. This means that there are always alternatives to manmade systems, that there is more than one way to accomplish a purpose or to proceed from here to there. In other words, the final state of any open system can be reached by starting from a number of different initial conditions and through a variety of means. This principle from General Systems Theory is called equifinality.

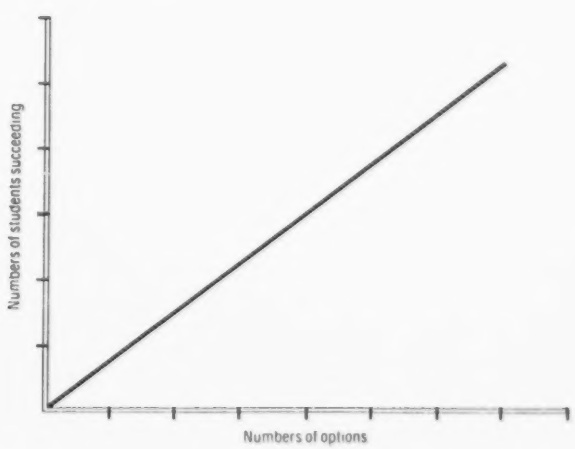
The equifinality of a system increases as the number of alternatives increases. A system also increases its ability to adjust to unforeseen changes in its environment as the system increases the number of ways it can achieve its purposes. Most importantly, as shown in Figure 3-6, as equifinality increases so does the probability that a system will accomplish its purposes and that students will succeed.

Many efforts to apply General Systems Theory in education do not show an understanding of the principle of equifinality. Efforts aimed at curriculum reform almost always attempt to replace the old system with a new or more fashionable system. Furthermore, when alternatives are developed within schools, they frequently exist as separate or competing entities when they should be considered as increasing options for students. For example, teachers too frequently fail to relate films to the lesson. The film stands as an independent system buying time for the teacher to correct papers or do some other chore. Another example comes from the experience of team teaching. Team-taught classes were generally regarded as competitive with traditional classes. The question is, which is best? The question should be, what part can educational films and team teaching play in the curriculum?

Notions about individualizing instruction do seem to increase the equifinality of an educational system. This is especially true if the classroom and the school provide numerous ways for students to learn through a variety of media and through the use of many teaching and learning strategies. On the other hand, if individualized instruction is conceived to be a student working endless hours at a computer terminal, then the principle of equifinality is ignored.

Understanding the principle of equifinality ought to increase the value educators place upon alternative ways to learn and decrease educator's preoccupation with trying to prove that this way is better than that way. This principle suggests that the greatest need is to increase the instructional

Figure 3-6. Equifinality.



repertoire of teachers. This is understood and explained in Models of Teaching (Joyce and Weil, 1972):

> Models for teaching can help a teacher build up his capacity to reach more children and create a richer and more diverse environment for them. They can help curriculum-makers plan learning centers and curriculums which offer to children a variety of educational alternatives. They can help materials makers create more interesting and effective instructional materials and learning sources.

CONCLUSIONS

The use of General Systems Theory, instructional design, and systems analysis has become fashionable during recent years. Unfortunately, these rather distinct efforts have become confused by writers, instructional materials developers, and curriculum workers. General System Theory provides the terminology for describing a whole, dynamic system while instructional and design and systems analyses tend to be step-by-step procedures for producing a product and/or achieving a goal. In other words, General Systems Theory tends to point to the inadequacies of a linear ends-means view of a system and emphasizes the reciprocal relationships among systems, subsystems, and suprasystems. Nevertheless, the literature seems to indicate that educators frequently confuse and/or use interchangeably instructional design, systems analysis, and General Systems Theory. Only a few efforts have been made to use General Systems Theory concepts such as equifinality to describe educational programs.

The key system within a district seems to be the classroom; however, this notion is rarely explored. Instructional design models tend to concentrate upon the production and validation of instructional products or the generation and implementation of a particular course or curriculum. The place in which the work of the schools is most always performed, the classroom, is badly neglected. The original design of the classroom appears amazingly versatile and capable of providing the environments necessary for the kinds of teaching and learning tasks that schols undertake.

In summary, the first step in using General Systems Theory seems to be missing--namely, to use concepts from General Systems Theory to develop a new understanding of why and how schools achieve what they achieve and behave as they do. To use General Systems Theory to justify a new program or to point to inadequacies of traditional schools neglects using General Systems Theory for the purpose it was intended and creates a situation in which practice is frequently in conflict with the theory that supposedly supports it.

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